Shade and nitrogen effects on regrowth dynamics, partitioning, and herbage production of Jiggs bermudagrass and Mulato-2 brachiaria hybrid.

Leonardo S. B. Moreno[1,2*], Kenneth J. Boote[1], Lynn E. Sollenberger[1], Marta M. Kohmann[1], and Diego N. L. Pequeno[3]

[1]University of Florida, Dept. of Agronomy, McCarty Hall, Gainesville, FL 32611-0500 USA
[2]Brazilian Agricultural Research Corporation – Embrapa – CNPASA, Palmas, TO 77020020 Brazil
[3]University of Florida, Dept. of Agricultural and Biological Engineering, Frazier Rogers Hall, Gainesville, FL 32611-0570 USA
* lsbmoreno@ufl.edu / leonardo.moreno@embrapa.br

Introduction and Objectives

- ✓ Forage plants are subjected to multiple defoliation and regrowth cycles each year, with most leaf area removed at each defoliation event.
- ✓ Understanding the role of assimilate partitioning in the regrowth process is important to improve physiology-based models, enhance management practices, and identify target traits in breeding programs.
- ✓ Objective: To quantify the effects of shade and N fertilization on C and N availability for plant growth, composition of stubble following defoliation, and partitioning of assimilates.

Materials and Methods

- ✓ Conducted at the Beef Research Unit of the University of Florida (Summer 2014). Randomized complete block design with four replicates.
- ✓ Treatments were factorial combinations of two species [Jiggs bermudagrass (*Cynodon dactylon* L. Pers.) and Mulato-2 (*Brachiaria spp.*)], two light levels (full sun and 55% shade) and two N rates (30 or 120 kg ha^{-1} of N after each 4-week harvest).
- ✓ The forages were harvested to a 10-cm stubble every 4 weeks using a sickle-bar mower.
- ✓ Samples of above and below ground material were collected during two consecutive regrowth cycles on days 0, 4, 9, 18 , and 28 after harvest staging.
- ✓ Growth analysis was performed using the equations: RGR=ULR*LAR, and LAR=LMF*SLA, where: RGR=Relative Growth Rate, ULR=Unit Leaf Rate, LAR=Leaf Area Ratio, LMF=Leaf Mass Fraction and SLA=Specific Leaf Area. SMF=Stem Mass Fraction
- ✓ Computed values for LMF and SMF are based on total above and belowground biomass and averaged over the outcome of all the sampled dates (thus initially low after each harvest).

Results and Discussion

- ✓ Seasonal forage dry matter accumulation of Mulato-2 was greater than Jiggs (8600 vs 6000 kg ha^{-1}) (*p<0.0001*) (Figure 1).
- ✓ Shaded treatments produced less forage compared with full sun treatments (6600 vs. 8100 kg ha^{-1} of DM) (*p<0.0001*) , and high N treatments produced more forage than low N treatments (7800 vs. 6900 kg ha^{-1} of DM) (*p=0.0112*) (Figure 1).
- ✓ Growth analysis resulted in no differences of ULR among treatments (*p>0,69*), thus herbage accumulation differences are not likely to be due to differences in leaf-level carbon assimilation. Hence, growth differences observed in Figure 1 are more closely related to changes in structural components.
- ✓ Leaf as a fraction of plant total biomass (LMF) was larger in Mulato-2 (9%) than in Jiggs (5%), and full sun plots had greater LMF (8%) than shaded plots (6%) (*p<0.001*). Leaf mass followed the same pattern as LMF (Figure 2).
- ✓ Stem mass fraction (SMF) was lower in Mulato-2 (9%) than in Jiggs (18%). Shade caused distinct effects on SMF between species. Shade decreased SMF of Jiggs, but increased SMF of Mulato-2 (*p≤0.01*) (Table 1).
- ✓ Mulato-2 had greater below-ground biomass than Jiggs, and shade reduced root biomass markedly relative to full sun, regardless of N rate. Shaded Mulato-2 showed a greater decrease in below-ground biomass (40%) compared to shaded Jiggs (27%) (Table 1).
- ✓ Jiggs had smaller SLAs overall (130 cm^2/mg) compared to Mulato-2 (236 cm^2/mg), but Mulato-2 leaves under full sun responded to N rates: 233 cm^2/mg under high N, and 208 cm^2/mg under low N (*p=0.01311*) (Figure 2).
- ✓ Shaded leaves increased SLA over time, showing higher values compared to non-shaded ones at the end of each growth cycle.

Figure 1. Seasonal forage dry matter accumulation from five consecutive harvests in 2014, paired by main effects.

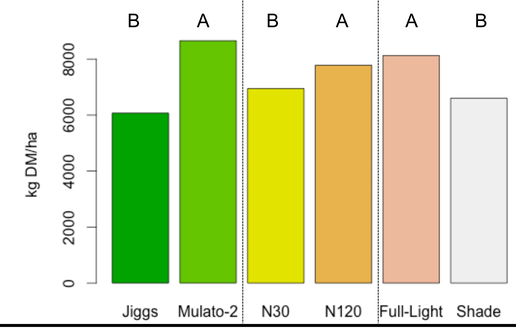

Figure 2. Leaf mass and SLA dynamics in two consecutive growth cycles of Jiggs (left panels) and Mulato-2 (right panels). Sun plants (black and red lines) have more leaf mass than shaded plants (blue and green). Mulato-2 had greater leaf biomass and SLA compared to Jiggs.

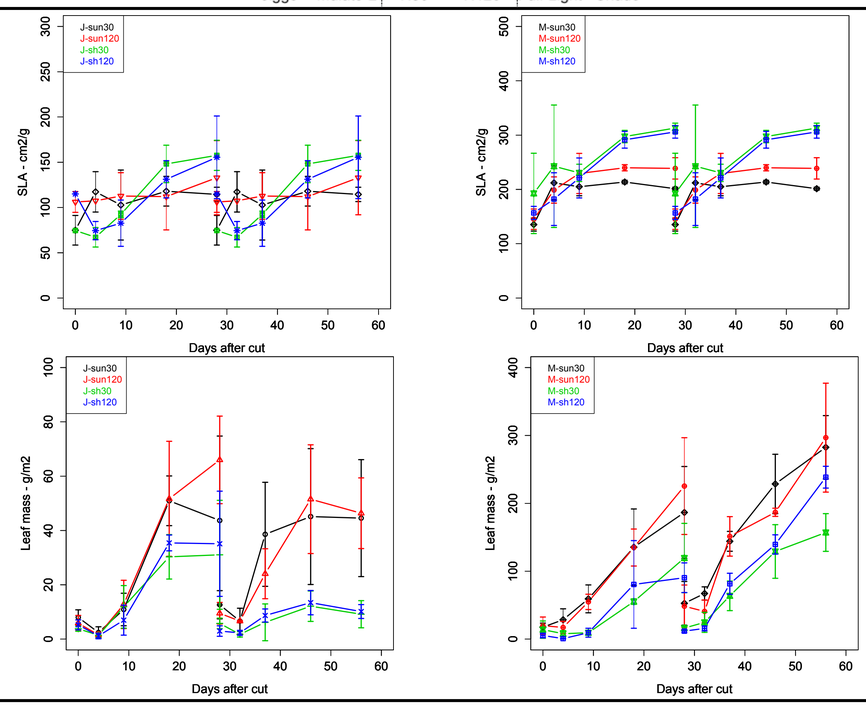

Table 1. Root biomass and SMF of the interaction Species by Light. Values in the same line, within species are different (*p≤0.01*).

	Jiggs		Mulato-2	
	Full Sun	**Shade**	**Full Sun**	**Shade**
Root Mass (g/m^2)	315	230	997	638
Stem Mass Fraction (%)	20	13	9.5	12

Conclusions

- ✓ N effects were not as evident as expected, although sufficient to affect SLA of non-shaded Mulato-2.
- ✓ SLA is one of the main traits plants change to adapt to the environment. Under low light, plants increase SLA (usually associated with thinner leaves) to capture as much light with minimum investment in leaf mass. Changes associated with N rates in Mulato-2 indicate a C:N compensation mechanism.
- ✓ Root is the main plant component as a proportion of total biomass. Although root mass is reduced under shade, proportionally it remains the predominant plant part.
- ✓ The results illustrate differences in growth habit of the different species, and also suggest that differences in partitioning of assimilates can influence potential production.

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